



LETTERS

Restoring degraded ecosystems effectively will require seeds from a wide variety of species.

Edited by Jennifer Sills

Aim for heterogeneous biodiversity restoration

Commitments to restore about 1 billion hectares by 2030 have emerged in the past decade (1), providing hope for tackling the global environmental crisis (2). However, restoration initiatives often use limited sets of species, with little regard for the regional diversity found in reference landscapes (3–5). In diverse tropical ecosystems, where restoring biodiversity is challenging [e.g., (6, 7)], such practices can lead to homogeneous biological communities and habitats that do not fulfill the purpose of restoration.

Restoration science is still evolving (2), especially in the tropics (8). The Arc of Restoration program in the Amazon, launched during the 2023 United Nations Climate Change Conference (COP28), promises to restore 6,000,000 hectares of land by 2030, about 0.9% of the total Amazon area (9). The Atlantic Forest Treaty, launched in October 2023, pledges to restore 54,000 hectares by 2026, about 0.05% of Atlantic

forests (10). These large restoration programs require complex supply chains for seed and plant material (11) and solid scientific knowledge about the species that comprise each ecosystem (7), both still limited in the tropics (7, 8, 11). To succeed, large-scale restoration requires the development of national and regional policies that promote the supply of considerable species sets (11), accounting for local and regional diversity.

Ideally, the heterogeneity found in reference ecosystems should guide goal setting and species selection (7, 12). Therefore, protecting natural remnants that serve as propagule sources and references for restoration is essential (7). Remnant ecosystems also contribute to ecological connectivity, enabling and accelerating natural colonization processes.

Restoration is expected to yield outcomes that mitigate and facilitate adaptation to climate change. Despite vast efforts and investment, if restoration practices do not recreate the diversity found in reference ecosystems, restoration will not achieve those goals. Moreover, if remnant ecosystems are lost and can no longer serve as references, restoration efforts will

be compromised. Conservation of remnant ecosystems must be prioritized, and restoration projects must aim for fully restored ecosystems, which will benefit the social, ecological, and economic sectors.

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